UCRSF 2.8.12
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Confederated Tribes of the Colville Reservation
Office of Environmental Trust
P. O. Box 150, Nespelem, WA 99155
Phone: 509-634-2425, Fax: 509-634-2427

February 14, 2005

Sally Thomas
EPA Region 10
1200 6th Avenue
Seattle, WA 98101

Dear Sally,

The Confederated Tribes of the Colville Reservation (CCT) are pleased to provide our comments on the Draft "Phase I Fish Tissue Sampling Approach and Rationale – Upper Columbia River Site CERCLA RI/FS" (Fish Sampling Plan) prepared by CH2MHill and Ecology and Environment, Inc. for the US Environmental Protection Agency Region 10 (EPA Region 10). CCT is supportive of EPA's efforts to investigate contamination in the fisheries of the Upper Columbia River Site (UCR). CCT understands the limited resources available to investigate the contamination in fish of UCR and intends these comments to help ensure that the most important and useful information is collected with these limited resources. CCT has a few general comments on the Fish Sampling Plan, which are presented first, as well as specific comments on portions of the plan, which are presented second.

General Comments

Previous Investigations, Section 2

Section 2 outlines prior investigations regarding UCR limnology and studies of the fisheries. It should be noted, however, that there has no been no systematic study of contaminants in the UCR and how they affect fisheries from an individual fish or a fishery population level. As a result, prior studies that suggest impacts from dam operation or limiting factors, such as phosphorus, are primarily responsible for impacts to fisheries are incomplete in their analysis of potential causative factors and fail to account for the potential impacts of hazardous substances. In fact, the RI/FS will be the first systematic effort to define the nature and extent of contamination and the risk that such contamination creates for both humans and organisms. As a result, the introductory Section 2 should be qualified to note this fact and provide a context for the prior studies

presented. The qualification could say something like – "To date, there has been no systematic investigation of the nature and extent of contamination, the risks presented by such contamination and the injuries to natural resources caused by it. As a result, the prior studies considering fishery health, dam operations and limiting factors in the environment are somewhat incomplete and are not determinative of all the factors (including hazardous substances) that may contribute to declines or injuries."

Along these lines, it is scientifically premature (and therefore not supportable) to have statements in the introduction that appear to present conclusions about dam operations and phosphorus driving the system. An illustrative example is as follows: "The decreasing trend for prey species appears to be caused by the lack of multiple reservoir elevation spawning and rearing refugia for spring spawning species resulting for seasonal spring and early summer reservoir operations, and walleye predation." See page 2-2. The fallacy in this conclusion is that there is no limiting language that there may be other "causes" or contributing factors, such as contaminants, for such declines. Statements interpreting earlier studies and presenting conclusions that seem to suggest that dam operations or phosphorus are sole causes/limitations to populations should not be included in this section; they should be removed.

Discussion of Fisheries in Section 2.1

It should be made clear that CCT has been actively involved with the management and monitoring of Lake Roosevelt since the inception of the Northwest Power Planning Council's Fish and Wildlife Programs in the late 1980s. CCT, the Spokane Tribe of Indians (STI), the Bureau of Indian Affairs, Bureau of Reclamation (BOR) and the National Park Service signed a five party agreement in 1990 for the co-management of Lake Roosevelt and this agreement remains in effect today.

The lack of any comprehensive enhancement measures in the late 1980s prompted the Upper Columbia United Tribes Fisheries Center (UCUT), CCT, STI and Washington Department of Fish and Wildlife (WDFW) to develop a comprehensive fishery management plan for Lake Roosevelt. The plan was amended, to the Columbia River Basin Fish and Wildlife Program, by the Northwest Power Planning Council (NPPC) in 1987.

The Lake Roosevelt Monitoring Project was one of the programs initiated as part of the Comprehensive Fishery Management Plan for Lake Roosevelt. STI took the lead on the project but included sub-contracts with CCT, WDFW and Eastern Washington University (EWU). All agencies have shared the monitoring and data collection responsibilities from the beginning.

In 2000, the project shifted from general monitoring of the lake to fisheries evaluation focusing heavily on the status of the hatchery production's recruitment to the lake's fishery. The project was renamed at this time Lake Roosevelt Fisheries Evaluation Project. Joint monitoring and creel by STI, CCT, WDFW and EWU have continued

under the new project. The BOR and the U.S. Army Corps of Engineers have never conducted biological monitoring of Lake Roosevelt.

Also in Section 2.1, the plan references twenty four species as having been identified within the fish community of Lake Roosevelt; however, we have identified twenty nine and have attached several tables for your review. In reviewing Table 2-2, pumpkinseed, chiselmouth, speckled dace, bull trout and cutthroat are missing. Pumpkin seed are the only non-native of this extra grouping. Remnant populations of both bull trout and cutthroat trout inhabit the upper reservoir area with bull trout being a listed species. This fact should be addressed in document. In addition, this document talks of recent fish releases but only lists 1988-1998 data. The last 6 years may be very important with respect to this sampling effort.

The plan states that rainbow trout are native and kokanee are non-native. There is actually a natural origin strain of kokanee that inhabit the lake that are not related to the Lake Whatcom hatchery origin strain. The native rainbow trout in the Lake Roosevelt watershed is the redband rainbow trout and some still exist in tributaries to Lake Roosevelt in isolated and protected habitats. For the most part, the rainbow trout that are found in Lake Roosevelt are hatchery origin coastal rainbow from the current rainbow trout net pen program.

However, a natural origin adfluvial rainbow trout also exist in the lake and reproduces in several tributaries. DNA analysis, using mitochondrial and nuclear RFLP markers along with two microsatellite loci, was conducted by Madison Powell and Joyce Faler at the Center for Salmonid and Freshwater Species at Risk at the University of Idaho/HFCES. Sample populations were screened for detectable levels of introgressive hybridization arising from possible admixtures of hatchery rainbow trout with native redband rainbow trout. Trout from the lower reaches of the San Poil River tributaries were found to have high levels of hybridization, and the genetic admix indicated that remnants of the native summer steelhead populations had created a hybrid migratory trout from the native redband rainbow trout, planted coastal rainbow trout and native summer steelhead. These hybrids spend part of their life cycle in the tributaries and part in Lake Roosevelt.

This section also lists walleye as the most abundant fish species in year 2000 surveys at 28% (data from STI) CCT's 1999 and 2000 surveys list largescale sucker as the most abundant both years at 30.2% and 29.0%, respectively. Walleye are listed only at 4.2% and 10.7%, respectively. Our 2001 samples found yellow perch to be the most abundant at 58.1%. Largescale suckers were second most abundant at 16.3% and walleye were at 4.8%. CCT's surveys are different than STI's (methods, areas etc), but this plan only addresses STI's. All available data should be included to identify the relative abundance of fish species relative better.

Target Species

CCT agrees with the species proposed for sampling but thinks the list should also include white sturgeon and freshwater clams. White sturgeon are a very important species to

CCT and the UCR ecosystem. In addition, white sturgeon mature late, forage in benthic habitats and forage at the top of the food chain so that they are very susceptible to the bioaccumulation of contaminants. As EPA is aware, CCT is working with the State of Washington, the Spokane Tribe and Canada to understand and restore white sturgeon to the Columbia River System. White sturgeon are an extremely long-lived species with substantial bioaccumulation potential and who are likely very susceptible to the contamination found at this site so that information on the contaminant levels in white sturgeon tissue should be collected as part of the RI/FS. CCT has requested that EPA perform needle biopsy or muscle plug testing in white sturgeon in the past and reiterates that request here. This technique has been shown to be feasible and not to cause undue harm to the fish. CCT will provide information to EPA on this technique under separate cover.

CCT understands that EPA is operating under a limited budget for this phase and tried to maximize the return on its investment in this sampling round; however, it is necessary to record this and the fact that this sampling is not as robust as EPA would normally perform at a site of this size. CCT requests that a statement be made in the plan that other species are worthy of sampling in future phases of the project. For example, burbot, freshwater clams and other species in the food web of the target species should be analyzed over the course of the project. Native Americans consume burbot and contaminant levels in burbot remain largely unknown. Additionally, the food web included as Figure 6-1 does not include burbot, a significant benthic predator. Freshwater clams have been observed in different locations around the site and are consumed by a variety of species. Finally, understanding contaminants in prey items of these species is imperative to understanding the transport and impacts of contaminants throughout the UCR ecosystem.

Focus of the Sampling Effort

The Fish Sampling Plan appears to overstate the objectives of this phase of study and gives the impression that sufficient data will be collected in this phase to complete human health and ecological risk assessments. The plan does state that a data gap analysis will be conducted after this phase, but the plan does not make it clear that significant data gaps are likely. As a result the plan should be revised to reflect more clearly the objectives for this phase and some indication of what level of analysis will be possible with the data generated. In addition, the plan should identify at least at a general level objectives for subsequent phases of sampling. EPA may want to provide overall objectives for fish sampling in the RI then indicate the portion that will be accomplished in each phase of the project.

The current plan appears to place the highest priorities on human health issues and comparability with previous sampling efforts. This approach has resulted in a plan that will provide insufficient information for robust risk assessments, especially ecological. CCT would prefer to see a sampling approach that includes more consideration of all appropriate data needs and eventual data uses. As stated previously, CCT understands the resource constraints under which EPA is operating; but this limitation should be

acknowledged in some manner in this sampling plan so that a reader understands what is to be accomplished in phase 1 and what is left for subsequent phases. CCT provides the following specific comments relevant to this issue to demonstrate the point of this comment.

Section 5.1

The discussion on the data requirements for the RI and risk assessments is insufficiently detailed. The specific requirements of data types for the data should be based on the requirements of the RI and both human health and ecological risk assessments. Instead, the present paradigm for selecting fish receptors appears to be based strictly on results of previous contaminant investigations, not on actual needs or requirements of the RI and risk assessments. All appropriate requirements should be identified and described then form the basis for fish species selection.

Section 6

The rationale for species selection in this section should be reorganized to focus on the RI and risk assessment requirements that were requested to be identified in the above comment on Section 5.1. The rationale should be linked more specifically to the needs of the RI and risk assessments.

Section 6.2 and 6.3

Following on the above comments, please reorganize these sections to first list the criteria for selecting receptors of concern and chemicals of potential concern, then make the selections by matching the possible species and chemicals in the system with the criteria. The criteria should be based on the needs and objectives of the RI and the risk assessments, not solely on species on which previous investigations focused.

Section 6.5

Assuming an attempt will be made to link fish tissue concentrations of chemicals of potential concern with those in potential sediment sources, home ranges of the fish species should be identified and matched with sediment sampling areas.

Sample Numbers

CCT requests that additional fish samples be collected for the purposes of being able to link detected contaminant levels in fish to contaminant levels in area sediment. This is particularly an issue for fish that are to be collected between focus areas. A single data point, as would be collected in these in-between areas, is insufficient for making any inferences about relationships between body loads and potential sediment sources. At a minimum 3 samples should be collected in all areas although 5 or 6 would be preferable. CCT requests that 5 to 6 composite samples of each species be collected in focus areas and 3 composite samples of each species be collected in focus areas. This is not unreasonable considering that it is in line with approaches EPA has taken at similar sites.

At the risk of being repetitive, CCT again acknowledges that resources are at a premium at this site so compromises must be made. Collecting one tissue sample in an area

appears to be so much of a compromise that the collected information will be virtually useless. Perhaps it would be worthwhile for all parties to have a frank discussion of available resources and costs of the various fish samples (including collection, processing, laboratory analysis, and interpretation and application of results) so that an agreement can be reached as to the best use of resources in terms of locations, species, numbers of samples, analytes, etc.

Specific Comments

Section 2.2, page 2-4
In the introductory paragraph, please note that the selection of target analytes and species is not to be based solely on previous studies of contaminants in fish but also on additional criteria that come out of studies on the fisheries ecology and physiogeography of the UCR.

Page 2-7
Please do not use the term "...dangerous to human or environmental health" in the discussion of the USGS study. Please rephrase this to say "poses a risk to human or environmental health."

Section 2.2.1
The discussions of previous studies in this section contain references to numbers and decisions that are often based on fish consumption levels that are not appropriate for tribal members. For example, the discussion of the 1989 Ecology study of mercury and dioxin in sportfish references the FDA action level for mercury. This number is not based on tribally appropriate fish consumption rates. Qualifications should be added to all of these discussions in this section to indicate that tribally appropriate fish consumption rates were not considered.

Section 2.2.7
Nothing is included about the current mercury advisory for smallmouth bass. This is a statewide advisory, which means it applies to Lake Roosevelt.

Section 2 Tables
It would be helpful to provide references as a footnote to the tables to make it easier to find the underlying information.

Table 2-2
Add additional information as provided in our attached tables.

Table 2-11
Furan levels for walleye in this table appear to be in error (TCDF 0.117 – 1574 pg/g w.w.). It appears that a decimal point has been left out. This should be corrected.

Figure 2-5
Please clarify if the whitefish in the figure are Lake or Mountain species.

Figure 2-6
Please clarify if the whitefish in the figure are Lake or Mountain species.

Section 4.1.3
Paragraph two of this section makes a reference to the "sand like nature of the coarse-grained slag fraction". This reference was also made in the Draft Plan for the Sediment Sampling Approach and Rationale document. The gross appearance of the slag may look like sand but the very sharp barbed shards more closely resemble glass not sand. To refer to the slag as "sand like" infers a benign and inert substance, which does not reflect the actual nature of slag or risks it poses. Furthermore, as slag moves downstream it breaks-up into smaller pieces and becomes more easily suspended and transported. Slag has been collected and documented on beaches on CCT's Reservation as far south as river mile 631 and may be even further downstream.

Figure 4-1
This figure includes a box for potential exposure routes that lists bioconcentration and bioaccumulation as exposure routes. Although CCT expects the forthcoming risk assessment work plan to contain the details on exposure routes, this figure should be revised because bioconcentration and bioaccumulation should not be considered routes of exposure. Examples of exposure routes are uptake across gills, ingestion of prey items, incidental ingestion of sediment, etc. Please revise this figure accordingly.

Table 5-1
This table does not do an adequate job of providing detail for making decisions on what data need to be collected. For example, specific criteria for selecting fish receptors of concern should consist of trophic level, life history (e.g., lifespan, known dietary preferences, home range), feeding level, recreational harvesting and previous contaminant studies. Whether a potential link between fish species and sediment contamination can be determined should also be considered a criterion (see comment on Section 6 above). Please provide more detail on dietary preferences, based on stomach content data. The potential for exposures to sediment and subsequent bioaccumulation should be based on trophic status, feeding habits and dietary sources, lifespan and other criteria that affect exposures.

This table also does not provide sufficient rationale for selecting analytes of concern. The selection process should be contained in Section 6, yet the chemicals of concern are already selected in Table 5-1, without rationale other than being the focus of previous investigations.

Section 6.1
This section could be improved by elaborating on the studies mentioned in the first paragraph. References should be included for the fish population sampling and feeding studies. Alternately, additional detail on the design and objectives of these studies could be provided in this section. Providing this information would allow reader to understand how this information should be interpreted and applied. For example, recent "population sampling" was designed more from the perspective of relative abundance rather than a

fully developed population study. Similarly, not all "feeding studies" are intended to be feeding studies; some are intended to study potential food sources in a system.

CCT would also like to make the following comment about this section. Individual testing of specific organs needs to be done (e.g. eyes, visceral fat, liver, milt sack, gonads, eggs, heads) as part of the RI. Specific organ testing could be conducted from the same fish used for fillets and whole body to reduce the number of fish needed. Once the organs were tested they could be combined with the fillets for the whole body testing. Higher concentrations in specific organs would indicate specific risk in utilization of large quantities of a specific organ. Because CCT Members sometimes use just the eyes or the reproductive organs, they may be exposed to much higher concentrations than anticipated even when using whole body analyses. High bioaccumulation occurs in the visceral fat, and specific information of the risk associated with the visceral fat is of importance. To the extent that testing cannot be included in phase 1, studies such as those just described should be noted as a data gap to be addressed in subsequent phases.

Section 6.3
The bulleted list of analytes includes "arsenic (organic and inorganic)" as a metal analyte. The discussion after this list only covers inorganic arsenic versus total arsenic. CCT requests clarification that organic arsenic will be part of the analysis.

Figure 6-1
This figure needs several revisions. The food web has three of the proposed species (lake whitefish, rainbow trout and largescale suckers) listed in the same trophic level as omnivorous fish. It would be more accurate to classify lake whitefish as insectivores and rainbow trout and suckers as planktivores. The accuracy of the food web could possibly be clarified by specifying the size class/age to be sampled, as the diet of most species is inclined to become more omnivorous over time. That is, as fish increase in size they become more omnivorous. For example, lake whitefish and largescale suckers are primarily planktivorous as juveniles, becoming piscivorous and omnivorous, respectively, as adults. Likewise, adult rainbow trout are more omnivorous than their planktivorous juvenile form. Kokanee are classified as herbivores in the food web; however, they are almost exclusively plankton feeders. Kokanee are a visible feeder that feed on daphnia, copepods, etc., and they are both active and passive feeders. Kokanee should not be put in the same category as chiselmouth and carp but should linked to plankton or macroinvertebrates. Finally, adult sturgeon should be classified as a carnivorous fish, while juveniles consume primarily insects and other invertebrates.

CCT would like to provide the following information about the proposed sampling areas. Tribal staff have spent considerable time in the UCR and have made these observations. These should help EPA as it continues through the planning process.

Area 1: EPA may get a few walleye and rainbow trout but only a few. This area has swift current will be difficult to electrofish. CCT collected wild rainbow trout here, and this is where CCT sampled for white sturgeon effort. If walleye are to be targeted in this area, a better site would be 2-3 miles lower adjacent to Big Sheep Creek estuary area.

Area 2: Again walleye and rainbow trout are likely to be encountered here with perhaps a few suckers. This is also an area of swift water and many vertical rock walls.

Area 3: This area has steep banks and cobble areas.

Area 4. EPA should find walleye, rainbow trout and suckers. A concern with all of these upper sites is that the longnose sucker is more predominate in this area.

Area 5: This is a productive area but is dependant on reservoir elevation. It will be difficult to find any lake whitefish above Kettle Falls.

Area 6: Perhaps this area should be moved or extended to include French Rocks area. This will be better to collect targeted species.

Area 7: Walleye, suckers and rainbow trout will dominate in this area. Walleye could be few and far between, but a gill net effort could be the difference in this area.

Area 8: This is one of the better selection sites.

Area 9: From this site downstream EPA should be able to find lake whitefish.

Area 10: It could be difficult to collect walleye of size in this area.

Area 11: Gill net placement and effort will be a major concern.

CCT appreciates the opportunity to comment on the Draft Fish Sampling Plan. As stated previously, CCT supports EPA in its efforts to investigate and clean up this important and valuable resource. Furthermore, CCT has attempted to consider the constraints under which EPA is operating in this effort, and is willing to work with EPA to ensure the best possible fish sampling effort is conducted. CCT looks forward to seeing a final report that incorporates the comments provided above.

Sincerely,

Gary Passmore, Director, Office of Environmental Trust
Confederated Tribes of the Colville Reservation

Table 6. Fish species found in Lake Roosevelt listing family, scientific name, common name, native (Y) or introduced species (N), lifespan, maximum length and weight, age at maturity and the type of substrate needed for spawning. Substrate Key: MS=Mud silt, SD=Sand, GR=Gravel, CB=Cobble

Family	Scientific Name	Common Name	Native	Lifespan	Max. Length	Max. Weight	Age at Maturity Years	Spawning Substrate
Acipenseridae	*Acipenser transmontanus*	White sturgeon	Y	100+ yrs.	610 cm.	820 kg.	M=4-24 F=8-32	CB
Cyprinidae	**Cyprinus carpio**	Carp	N	20+ yrs.	122 cm	42 kg.	M=3-4 F=4-5	MS/SD
	Mylocheilus caurinus	Peamouth	Y	13 yrs.	36 cm.	600 gm.		GR
	Acrocheilus alutaceus	Chiselmouth	Y	6 yrs.	31 cm.	500 gm.	M=3 F=3-4	GR
	Ptychocheilus oregonensis	Northern pikeminnow	Y	15-20 yrs	63 cm.	13 kg.	6	GR/CB
	Richardsonius balteatus	Redside shiner	Y	7 yrs.	18 cm.	250 gm.	3	MS/SD
	Rhinichthys osculus	Speckled dace	Y	7 yrs.	11 cm.	150 gm.	2+	GR
	Tinca tinca	Tench	N	5 yrs	84 cm.	3.9 kg.	4	MS/GR
Catostomidae	*Catostomus catostomus*	Longnose sucker	Y	19-24 yrs.	64.2 cm.	3.31 kg	M=4-8 F=5-9	GR
	Catostomus macrocheilus	Largescale sucker	Y	15 yrs.	61 cm.	3.2 kg.	M=5 F=6	GR
	Catostomus columbianus	Bridgelip sucker	Y	Unknown	38 cm	2.5 kg.	5-9	GR/SD/MS
Ictaluridae	Ameiurus nebulosus	Brown bullhead	N	6-9 years	55 cm.	3.6 Kg.	2-3	MS/SD
Salmonidae	**Coregonus clupeaformis**	Lake whitefish	N	28-30 yrs.	60 cm.	19 kg.	4-8	SD-GR
	Prosopium williamsoni	Mountain whitefish	Y	18 yrs.	56 cm.	1.8 kg.	3-4	SD/GR/MS
	Oncorhynchus mykiss	Rainbow trout	Y	6-11 yrs.	122 cm	24 kg	3-5	GR
	Oncorhynchus clarki	Cutthroat trout	Y	4 -7 yrs.	76 cm.	19 kg.	3-4	GR
	Oncorhynchus nerka	Kokanee	Y	2-8 yrs. (4)	76 cm.	3.6 kg.	2-4	GR
	Oncorhynchus tshawytscha	Chinook	Y	2-9 yrs.	136 cm.	57 kg.	2-9	GR
	Salvelinus confluentus	Bull trout	Y	12+ yrs	130 cm.	15 kg.	4-7	GR
	Salmo trutta	Brown trout	N	8-10 yrs.	103 cm.	18.3 kg.	2-4	1-3" GR
	Salvelinus fontinalis	Eastern brook trout	N	5-15 yrs.	86 cm.	6.6 kg.	2-3	GR
Gadidae	Lota lota	Burbot	Y	10-20 yrs	152 cm.	34.1 kg.	3-4	GR/MS
Cottidae	*Cottus sp.*	Sculpin spp.	Y	6-7 yrs.	15 cm.	.2 kg.	2-3	CB/GR
Centrarchidae	*Micropterus dolomieu*	Smallmouth bass	N	8-15 yrs.	69 cm.	6.4 kg.	M=3-5 F=4-6	GR
	Micropturus salmoides	Largemouth bass	N	13-23 yrs.	97 cm.	10.1 kg.	M=3-4 F=4-5	MS/SD
	Pomoxis nigromaculatus	Black crappie	N	8-13 yrs.	56 cm.	2.72 kg.	2-3	MS/SD
	Lepomis gibbosus	Pumpkinseed	N	8-10 yrs.	30 cm.	.63 kg.	1-3	MS/SD
Percidae	**Perca flavescens**	Yellow perch	N	7-13 yrs.	54 cm.	1.91 kg.	M=2-3 F=3-4	MS
	Sander vitreus	Walleye	N	12-20 yrs.	107 cm.	11.4 kg.	M=2-4 F=3-6	GR/CB

Table 7. Fish species found in Lake Roosevelt listing common name, spawning habitat, nursery habitat and months of spawning activity, X/ = First ½ of month /X = Last ½ of month.

Common Name	Habitat For Spawning	Habitat For Nursery	Months of Spawning											
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
White sturgeon	Riverine	Riverine					X/X	X/X	X/X					
Carp	Lacusterine-Riverine	Lacusterine-Riverine				X/X	X/X	X/X	X/X	X/				
Peamouth	Lacusterine	Lacusterine					X/X	X/X						
Chiselmouth	Riverine	Lacusterine-Riverine						X/X	X/X					
Northern pikeminnow	Lacusterine-Riverine	Lacusterine-Riverine					X/X	X/X	X/					
Redside shiner	Lacusterine-Riverine	Lacusterine-Riverine					X/X	X/X	X/X	X/X				
Speckled dace	Riverine	Riverine					/X	X/X	X/X	X/				
Tench	Lacusterine	Lacusterine					X/X	X/X	X/X	X/				
Longnose sucker	Riverine	Lacusterine				X/X	X/X	X/X	X/					
Largescale sucker	Lacusterine-Riverine	Lacusterine				X/X	X/X							
Bridgelip sucker	Lacusterine-Riverine	Lacusterine				/X	X/X	X/X						
Brown bullhead	Lacusterine-Riverine	Lacusterine-Riverine				X/X	X/X	X/X						
Lake whitefish	Lacusterine-Riverine	Lacusterine-Riverine	X/X									X/X	X/X	X/X
Mountain whitefish	Lacusterine-Riverine	Lacusterine-Riverine										X/X	X/X	
Rainbow trout	Lacusterine-Riverine	Lacusterine-Riverine			X/X	X/X	X/X	X/X	X/					
Cutthroat trout	Lacusterine-Riverine	Lacusterine-Riverine				X/X	X/X	X/X	X/					
Kokanee	Lacusterine-Riverine	Lacusterine-Riverine									/X	X/X	X/X	X/X
Chinook	Riverine	Lacusterine							X/X	X/X	X/X	X/X		
Bull trout	Riverine	Lacusterine-Riverine									X/X	X/X	X/X	
Brown trout	Riverine	Lacusterine-Riverine									/X	X/X	X/X	X/X
Eastern brook trout	Lacusterine-Riverine	Lacusterine-Riverine									X/X	X/X	X/X	
Burbot	Lacusterine-Riverine	Lacusterine-Riverine	X/X	X/X	X/X									
Sculpin spp.	Lacusterine-Riverine	Lacusterine-Riverine				X/X	X/X	X/X						
Smallmouth bass	Lacusterine-Riverine	Lacusterine-Riverine				X/X	X/X	X/X						
Largemouth bass	Lacusterine-Riverine	Lacusterine-Riverine					X/X	X/X	X/					
Black crappie	Lacusterine-Riverine	Lacusterine-Riverine				/X	X/X	X/X	X/X					
Pumpkinseed	Lacusterine-Riverine	Lacusterine-Riverine				X/X	X/X	X/X	X/					
Yellow perch	Lacusterine-Riverine	Lacusterine				X/X	X/X							
Walleye	Lacusterine-Riverine	Lacusterine-Riverine			/X	X/X	X/X	X/X						

Table 8. Fish species found in Lake Roosevelt listing common name, if macrophytes are preferred or needed for spawning and/or juvenile rearing, type of spawner, egg type, fecundity, egg size and time to hatching and juvenile and adult food preferences. Food Key: A= Algae, MI= Invertebrates, I= Insects, P=Plankton,D=Diatoms, L=Larvae, M= Molluscs, S=Snails, C= Crustaceans, F= Fish, FE= Fish Eggs, FF=Fish Fry, O= Offal, W=Waste

Common Name	Macrophyes Needed		Spawn Type	Egg Type	Fecundity- (Egg Size)	Time to Hatch	Juvenile Food	Adult Food
	Spawning	Rearing						
White sturgeon	N	Y	Broadcast	Adhesive, Sink	100K-5Million (4mm)	5-7 D.	MI, P, M	MI, M, C, F
Carp	Y	Y	Broadcast Small Groups	Adhesive	36K-2.2Million (1 mm)	3-6 D.	A, MI, I	A, MI, I, M, C, O, W
Peamouth	N	Y	Shore, 1F/2+M, 2" Water	Adhesive	5000-30000	Days	I, L	I, L, P, M, C, FE,F
Chiselmouth	N	Y	Stream, Broadcast, Some Buried	Adhesive	5000-7000	Days	A, I, P, D	A, I, P, D
Northern pikeminnow	N	Y	Water Column Released-sink	Adhesive, Sink	12K-100K(1 mm)	7 D.	I, L, P, C	I, L, P, C, FE, FF, F
Redside shiner	Y	Y	Substratum Egg Scatters 1F/2M	Adhesive	830-3600 (1.9-2.2 mm)	3-15 D.	P	A, L, I, M, FE, F
Speckled dace	N	Y	Cluster Spawners-Guarders	Adhesive	200-1200 (.1 mm)	7-14 D.	A, P	A, MI, I, P
Tench	Y	Y	Substratum Egg Scatters	Adhesive	30K-900K (1 mm)	Days	A, L	L, MI, I, M
Longnose sucker	N	Y	Substratum Egg Scatters	Adhesive	14K-89K (2.8-3 mm)	14 D.	A, L	A, L
Largescale sucker	N	Y	Substratum Egg Scatters	Adhesive	20K (2.5 mm)	14 D.	A, P, W	A, MI, I, FE
Bridgelip sucker	N	Y	Substratum Egg Scatters	Adhesive	Unknown (2.8 mm)	Unknown	A, P, W	A, MI, I, FE
Brown bullhead	N	Y	Nest, Guarder	Adhesive	1500-13800(3 mm)	5-8 D.	MI, I	MI, I, C, FE, F, O, W
Lake whitefish	N	N	Open Substratum Spawner	Smooth	25K-415K (2.3 mm)	6 M.	MI, I, P	MI, I, P, S, FE, F
Mountain whitefish	N	N	Open Substratum Spawner	Smooth	1400-24000 (3.7 mm)	5 M.	MI, I, P	MI, I, P, FE, F
Rainbow trout	N	N	Brood Hiders (Redds)	Smooth	200-12500 (3-5 mm)	4 -7 W.	I, P, MI	I , P, MI, S, F, FE
Cutthroat trout	N	N	Brood Hiders (Redds)	Smooth	100-5000 (4.3-5.1 mm)	6-7 W.	I, P	I, F
Kokanee	N	N	Brood Hiders (Redds)	Smooth	350-1800 (4.5-5 mm)	48-140 D.	P	P
Chinook	N	N	Brood Hiders (Redds)	Smooth	4000-14000 (6-7 mm)	6 M.	MI, I	F
Bull trout	N	N	Brood Hiders (Redds)	Smooth	100-10K (4.5-5.5 mm)	99-145 D.	MI, I	F, I, FE
Brown trout	N	N	Brood Hiders (Redds)	Smooth	100-7500 (4-5 mm)	4 -5 M.	MI, I	F, I, FE
Eastern brook trout	N	N	Brood Hiders (Redds)	Smooth	100-5000 (3.5-5 mm)	90-140 D.	MI, I	F, I, FE
Burbot	N	Y	Open Substratum Spawner, Orgy	Not Sticky	45K-1.4Million (.5mm)	30 D.	MI, I	C, F
Sculpin spp.	N	N	Crevace/Burrow Spawners	Adhesive	20-350 (<1-2.5 mm)	21 D.	MI, I, L	MI, F, FE
Smallmouth bass	N	Y	Nest Spawners-Male Tended	Adhesive	2K-28K (1.2-2.5 mm)	6-10 D.	MI, P	I, M, C, F
Largemouth bass	Y	Y	Nest Spawners-Male Tended	Adhesive	2K-110K (1.5-1.7 mm)	3-5 D.	MI	M, C, F
Black crappie	Y	Y	Nest Spawners-Male Tended	Adhesive	3K-188K (<1.0 mm)	3-5 D.	MI,	L, FF, F
Pumpkinseed	Y	Y	Nest Spawners-Male Tended	Adhesive	1680-7000 (1.0 mm)	3-5 D.	MI, I	I, S, FE & FF
Yellow perch	Y	Y	Open Substratum Spawner,	Sheathed, Adhesive	900-210K (3.5 mm)	8-20 D.	MI, I	I, F
Walleye	N	Y	Open Substratum Spawner	Sticky 1 Hr.	23K-615K (1.5-2.0mm)	12-18 D.	MI, F	I, C, F